RECOGNITION OF THE GEOLOGIC FRAMEWORK OF PORPHYRY DEPOSITS ON ERTS-1 IMAGERY

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16. Abstract

Preliminary analysis of a mosaic composing 20 individual ERTS frames (scale 1:1,000,000) that covers most of Nevada and western Utah reveals both new and old structural features. Three separate provinces, the Basin and Range, the Southern extension of the Columbia River Plateau volcanics, and the western edge of the Colorado Plateau are easily distinguishable. A West-Northwest "cross" or transverse structural trend, the Las Vegas Shear zone, is present in the region running from the Sierra Nevada to Lake Mead. The Sevier, Hurricane and Grand Wash faults that define the Wasatch-Jerome structural zone, can be traced further on the ERTS imagery than on existing tectonic maps. By use of a stereo viewer on the side-lap coverage of ERTS imagery, it is possible in some instances to determine the dip direction of sedimentary beds, enabling anticlines and synclines to be mapped. Other geologic features, i.e., faults, direction of throw on faults, recent basalt flow contacts with older rhyolitic tuffs, volcanic cones and subsidences can also be mapped.

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Preface

(a) Objective: The proposed investigation will examine the general hypothesis that mineral deposits of the copper/molybdenum porphyry type occur in a characteristic geologic setting which is recognizable in the surface data presented on space acquired imagery.

(b) Scope of Work: First a "naive" interpretation of ERTS imagery for the six test sites is prepared. It includes regional tectonic features, more detailed fault lines, and geologic formations. These interpretations are done without a prior knowledge of the area and are then compared to a readiness file of both published and company geologic, geophysical and geochemical maps. In addition, color composites and image enhancement of ERTS imagery supplemented at three test sites with color and color IR aerial photography will be studied to see if hydrothermal mineralization can be detected by optical manipulations and observed changes in hues in ERTS imagery and/or aircraft photography.

(c) Conclusions: So far, a preliminary analysis of ERTS imagery indicates that major tectonic lineations, dips of sedimentary beds and other major geologic features can be correlated with published geologic maps, but that substantially more regional features can be identified on ERTS than are indicated on published maps. Aircraft color IR photography appears to be helpful in identifying bedrock windows in alluviated desert areas.

(d) Summary of Recommendations: The slow delivery (over two months from placement) of color composite transparencies has delayed the start on image-enhancement techniques for detection of mineralization signatures. It is recommended that either faster delivery be made on these transparencies or that automatic distribution of acceptable frames in the central part of the test sites be made to the Principal Investigator within a two-week period after the individual MSS channels are sent. The utility of the microfilm catalog for the selection of spatial duplication in areas with high cloud cover would be materially improved if the processing were modified to make the image annotation blocks legible.

Main Text

Structural Trends

The first test site to be interpreted out of the six sites is Ely, Nevada. The photo mosaic composed of 20 individual ERTS frames (scale 1:1,000,000) that covers most of Nevada and western Utah displays many structural features. Three separate provinces, the Basin and Range, southern extension of the Columbia River Plateau, and the western edge of the Colorado Plateau are easily distinguishable. A West-Northwest "cross" or transverse structural trend (Las Vegas Shear zone) is present in the region running from the Sierra Nevada to Lake Mead. The Sevier, Hurricane, and Grand

Wash faults that define the Wasatch-Jerome structural zone can be traced to a greater extent on the ERTS imagery than on existing tectonic maps.

By use of a stereo viewer (X3 magnification) and side-lap coverage of 9" x 9" frames of ERTS imagery, it is possible in some instances to determine the dip direction of sedimentary beds, enabling anticlines and synclines to be mapped. Other geologic features, i.e., faults, direction of throw on faults, volcanic cones and subsidences can also be mapped.

Geologic Mapping

Many ground-mapped lithological boundaries cannot be determined on ERTS imagery. However, the grey level contrast differences and stream patterns on rock outcrops enables the assignment of a Geologic Legend based on rock units of broad classifications with similar time ages. For example, contacts between the Quaternary basalt flows and the underlying Tertiary rhyolite extrusives can easily be mapped. Cenozoic sedimentary rocks can usually be distinguished from older Paleozoic to Mesozoic sedimentary and metamorphic rocks by their less developed stream and foliation pattern.

Other Accomplishments

The preparation of suitable base, geology, geophysical and geochemical maps has been completed except for recently issued ones for Alaska and Australia. These have been ordered and should be completed within the next two months.

The Data Analysis Plan was prepared and submitted for approval on January 2, 1973.

Program for Next Reporting Interval

The work we have planned between now and the next reporting period will depend upon the receipt of satisfactory imagery of the other test sites. The primary problem pertaining to the receipt of imagery has been the greater cloud cover than specified as acceptable over four of our six test sites in our indicated time frames. These are Leadville, Colorado; Tanacross, Alaska; Queensland, Australia; and Ok Tedi, New Guinea. Snow cover may also be a problem on the Leadville, Colorado test site. Both conditions make good geologic interpretation difficult. We have been awaiting the post-September 23 imagery catalogs before placing orders for imagery with greater than 10% cloud cover and imagery collected after our original time frames in hopes that we may be able to secure spatial duplication that would enable us to proceed with our interpretation.

As mentioned in our Data Analysis Plan, the Leadville, Colorado site appears to have the poorest coverage and if adequate supplemental coverage is not available we would like to move this particular test site area to the southwest to take in an equally interesting mining district of which Kennecott Copper Corporation has extensive knowledge and ground control. This would be the same size area and would center on Silverton, Colorado, 120 miles

southwest. This alternate test site, like the original, is in the Colorado Mineral Belt, and provides a similar mineral environment and is well documented in the public and private literature. We have discussed this possibility briefly with our Scientific Monitor, Mr. D. Nava, and he is agreeable to the change if we find that not enough suitable imagery from the Leadville area is available. We do not anticipate that the change would require any additional aircraft support.

With the above paragraph in mind, we have planned the following work between now and the next reporting period:

(1) Completion of the interpretation of the Ely, Nevada test site
(2) Completion of the Ray, Arizona test site
(3) Start on a third test site if acceptable cloud coverage imagery is received from NASA
(4) Examine and interpret Underflight IR color. Requested underflight natural color has not been received but will be examined in conjunction if received in time.

(5) Examine and interpret ERTS color composite transparancies from the Ely and Ray test sites for mineralization and alteration zones if received from NASA.

Conclusions

A preliminary analysis of the ERTS imagery indicates that major tectonic lineations and other geological features can be mapped and correlated with published geologic maps. In the case of major fault zones, these can be traced further on ERTS imagery than is indicated on most tectonic maps.

Recommendations

The slow delivery (over two months from placement) of color composite transparencies makes it difficult to start on image enhancement techniques for detection of mineralization. It is recommended that either faster delivery be made on these transparencies in response to retrospective requests or that automatic distribution of acceptable frames in the central part of the test sites be made to the Principal Investigator within a two-week period after the individual MSS channels are sent. Microfilm catalog processing should be modified to render the image annotation blocks legible, thereby materially increasing the utility of the catalog in selecting imagery for retrospective request.